



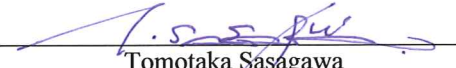
RADIO TEST REPORT


Test Report No. : 31KE0354-HO-01-A

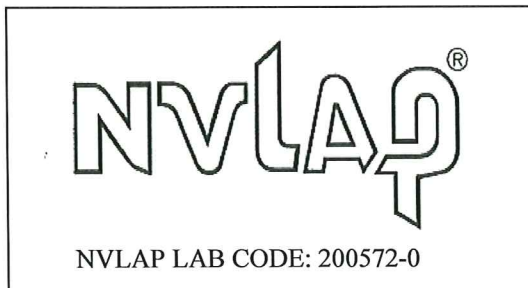
Applicant : Murata Manufacturing Co., Ltd.
Type of Equipment : Communication Module
Model No. : LBEE5ZSTNC
FCC ID : VPYLBTN
Test regulation : FCC Part 15 Subpart C: 2010
Test Result : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
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Date of test: July 11 to 21, 2011

Representative test engineer: 
Tomotaka Sasagawa
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UL Verification Service

Approved by: 
Takahiro Hatakeda
Leader of WiSE Japan,
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SECTION 1: Customer information

Company Name : Murata Manufacturing Co., Ltd.
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Contact Person : Takaharu Kawakatsu

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment : Communication Module
Model No. : LBEE5ZSTNC
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC1.8V/3.6V
Receipt Date of Sample : July 11, 2011
Country of Mass-production : Japan
Condition of EUT : Engineering prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT : No Modification by the test lab

2.2 Product Description

General Specification

Clock frequency(ies) in the system : REF_CLK: 38.4MHz, SLOW_CLK: 32.768kHz
Operating temperature range : -30 to +75 deg. C

Radio Specification

WLAN 11b/g/n-20

Radio Type : Transceiver
Frequency of Operation : 2412-2462MHz
Modulation : 11b: DSSS, 11g/n-20: OFDM
Power Supply (radio part input) : DC3.6V
Antenna type : Mono-pole antenna
Antenna Gain : +0.8dBi

Bluetooth

Radio Type : Transceiver
Frequency of Operation : 2402-2480MHz
Modulation : FHSS
Power Supply (radio part input) : DC3.6V
Antenna type : Mono-pole antenna
Antenna Gain : +0.8dBi

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2010, final revised on December 6, 2010 and effective January 5, 2011

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928MHz,
2400-2483.5MHz, and 5725-5850MHz

3.2 Procedures and results

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|---|---|--|--|----------|------------------------|
| Conducted Emission | FCC: ANSI C63.4:2003 7. AC powerline Conducted Emission measurements IC: RSS-Gen 7.2.4 | FCC: Section 15.207 IC: RSS-Gen 7.2.4 | QP 16.8dB, 4.81988MHz, L AV 16.1dB 11.80706MHz, N 4.81988MHz, L | Complied | - |
| 6dB Bandwidth | FCC: "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" IC: RSS-Gen 4.6.2 | FCC: Section 15.247(a)(2) IC: RSS-210 A8.2(a) | See data. | Complied | Conducted |
| Maximum Peak Output Power | FCC: "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" IC: RSS-Gen 4.8 | FCC: Section 15.247(b)(3) IC: RSS-210 A8.4(4) | | Complied | Conducted |
| Power Density | FCC: "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" IC: - | FCC: Section 15.247 (e) IC: RSS-210 A8.2(b) | | Complied | Conducted |
| Spurious Emission Restricted Band Edges | FCC: "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" IC: RSS-Gen 4.9 | FCC: Section15.247(d) IC: RSS-210 A8.5 RSS-Gen 7.2.3 | 1.3dB 2390.00MHz, PK, Vert. | Complied | Conducted/ Radiated |

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

* In case any questions arise about test procedure, ANSI C63.4: 2003 is also referred.

FCC 15.31 (e)

The stable voltage (DC3.6V) is constantly provided with the EUT through the regulator installed in the end product. Therefore, the EUT complies with the requirement.

FCC Part 15.203/212 Antenna requirement

It is impossible for end users to replace the antenna, because it is soldered on the circuit board. Therefore, the equipment complies with the antenna requirement of Section 15.203/212.

3.3 Addition to standard

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|------------------------|-------------------|-------------------|--------------|---------|-----------|
| 99% Occupied Bandwidth | IC: RSS-Gen 4.6.1 | IC: RSS-Gen 4.6.1 | N/A | - | Conducted |

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

EMI

The following uncertainties have been calculated to provide a confidence level of 95% using a coverage factor k=2.

| Test room (semi-anechoic chamber) | Conducted emission (+dB) |
|--------------------------------------|-----------------------------|
| | 150kHz-30MHz |
| No.1 | 3.1dB |
| No.2 | 3.3dB |
| No.3 | 3.7dB |
| No.4 | 3.2dB |

| Test room (semi-anechoic chamber) | Radiated emission | | | | | | |
|--------------------------------------|-------------------|------------------|-----------------|----------------|-----------------|-------------------|-------------------|
| | (3m*)(+dB) | | | | (1m*)(+dB) | | (0.5m*)(+dB) |
| | 9kHz -30MHz | 30MHz -300MHz | 300MHz -1GHz | 1GHz -10GHz | 10GHz -18GHz | 18GHz -26.5GHz | 26.5GHz -40GHz |
| No.1 | 3.5dB | 5.1dB | 5.2dB | 4.8dB | 5.1dB | 4.4dB | 4.3dB |
| No.2 | 4.0dB | 5.1dB | 5.2dB | 4.8dB | 5.0dB | 4.3dB | 4.2dB |
| No.3 | 4.2dB | 4.7dB | 5.2dB | 4.8dB | 5.0dB | 4.5dB | 4.2dB |
| No.4 | 4.0dB | 5.0dB | 5.1dB | 4.8dB | 5.0dB | 5.1dB | 4.2dB |

*3m/1m/0.5m = Measurement distance

| Power meter (+dB) | |
|-------------------|------------|
| Below 1GHz | Above 1GHz |
| 1.0dB | 1.0dB |

| Antenna terminal conducted emission and Power density (+dB) | | | Antenna terminal conducted emission (+dB) | | Channel power (+dB) |
|--|-----------|------------|--|---------------|------------------------|
| Below 1GHz | 1GHz-3GHz | 3GHz-18GHz | 18GHz-26.5GHz | 26.5GHz-40GHz | |
| 1.0dB | 1.1dB | 2.7dB | 3.2dB | 3.3dB | 1.5dB |

Conducted Emission test

The data listed in this test report has enough margin, more than the site margin.

Radiated emission test

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

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3.5 Test Location

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| | FCC Registration Number | IC Registration Number | Width x Depth x Height (m) | Size of reference ground plane (m) / horizontal conducting plane | Other rooms |
|----------------------------|-------------------------|------------------------|----------------------------|--|------------------------|
| No.1 semi-anechoic chamber | 313583 | 2973C-1 | 19.2 x 11.2 x 7.7m | 7.0 x 6.0m | No.1 Power source room |
| No.2 semi-anechoic chamber | 655103 | 2973C-2 | 7.5 x 5.8 x 5.2m | 4.0 x 4.0m | - |
| No.3 semi-anechoic chamber | 148738 | 2973C-3 | 12.0 x 8.5 x 5.9m | 6.8 x 5.75m | No.3 Preparation room |
| No.3 shielded room | - | - | 4.0 x 6.0 x 2.7m | N/A | - |
| No.4 semi-anechoic chamber | 134570 | 2973C-4 | 12.0 x 8.5 x 5.9m | 6.8 x 5.75m | No.4 Preparation room |
| No.4 shielded room | - | - | 4.0 x 6.0 x 2.7m | N/A | - |
| No.5 semi-anechoic chamber | - | - | 6.0 x 6.0 x 3.9m | 6.0 x 6.0m | - |
| No.6 shielded room | - | - | 4.0 x 4.5 x 2.7m | 4.75 x 5.4 m | - |
| No.6 measurement room | - | - | 4.75 x 5.4 x 3.0m | 4.75 x 4.15 m | - |
| No.7 shielded room | - | - | 4.7 x 7.5 x 2.7m | 4.7 x 7.5m | - |
| No.8 measurement room | - | - | 3.1 x 5.0 x 2.7m | N/A | - |
| No.9 measurement room | - | - | 8.0 x 4.5 x 2.8m | 2.0 x 2.0m | - |
| No.10 measurement room | - | - | 2.6 x 2.8 x 2.5m | 2.4 x 2.4m | - |
| No.11 measurement room | - | - | 3.1 x 3.4 x 3.0m | 2.4 x 3.4m | - |

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test set up, Data of EMI, and Test instruments

Refer to APPENDIX.

SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

Test operating mode was determined as follows according to “Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009.

| Mode | Remarks* |
|---|------------|
| IEEE 802.11b (11b) | 2Mbps, PN9 |
| IEEE 802.11g (11g) | 9Mbps, PN9 |
| IEEE 802.11n SISO 20MHz BW (11n-20) | MCS0, PN9 |
| *The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel) | |

Power of the EUT was set by the software as follows:

Software name & version: TrioScope, ver.: 6.2.0.6

[Power Setting]

| ch | 1 | 2 to 10 | 11 |
|--------|------|---------|------|
| 11b | 20.5 | 20.5 | 20.5 |
| 11g | 16 | 20 | 16 |
| 11n-20 | 15.5 | 20 | 15.5 |

*The above setting of the software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.

*Details of Operating mode(s)

| Test Item | Operating Mode | Tested frequency |
|---|-----------------|------------------|
| Conducted Emission | 11g Tx *1) | 2437MHz *1) |
| Maximum Peak Output Power | 11b Tx | 2412MHz |
| | 11g Tx | 2437MHz |
| | 11n-20 Tx | 2462MHz |
| Spurious Emission | 11b Tx | 2412MHz |
| | 11g Tx *2) | 2437MHz |
| | | 2462MHz |
| | 11n-20 Tx | 2412MHz |
| | *Band Edge only | 2462MHz |
| 6dB Bandwidth | 11b Tx | 2412MHz |
| Power Density | 11g Tx *2) | 2437MHz |
| 99% Occupied Bandwidth | | 2462MHz |
| *1) The mode was tested as a representative, because it had the highest power at antenna terminal test and the noise level at the mode/channel was equivalent to that of other mode/tested frequency. | | |
| *2) The mode was tested as a representative, because it had the higher power compared to 11n-20 Tx mode. | | |

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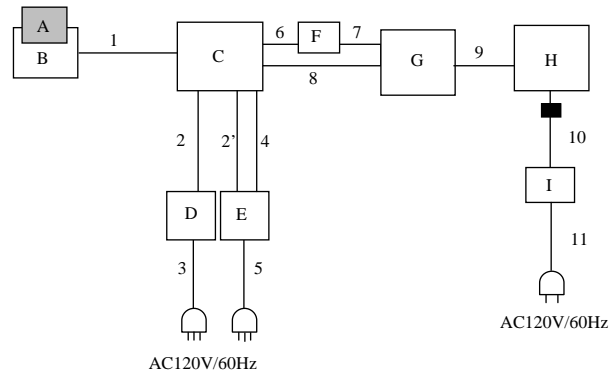
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4.2 Configuration and peripherals



*Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

Description of EUT

| No. | Item | Model number | Serial number | Manufacturer | Remarks |
|-----|----------------------|---------------|----------------------------|--------------------------------|---------|
| A | Communication Module | LBEE5ZSTNC | 001 *1) 002 *2) | Murata Manufacturing Co., Ltd. | EUT |
| B | Jig Board | - | - | Murata Manufacturing Co., Ltd. | EUT |
| C | Jig Board | - | - | Murata Manufacturing Co., Ltd. | - |
| D | DC Power Supply | PMC35-2A | 13090501 | KIKUSUI ELECTRONICS CORP. | *3) |
| E | DC Power Supply | PW18-1.3AT | 09067054 | KENWOOD | - |
| F | Converter | - | 91211900 | - | - |
| G | USB Hub | U2H-H4SSV | 001884C | ELECOM | - |
| H | Personal Computer | TYPE 2973-GQ7 | L3-03T2G | IBM | - |
| I | AC Adaptor | 92P1020 | 11S92P1020Z1 Z9RM67H1YC | IBM | - |

*1) Used for Antenna Terminal Conducted test

*2) Used for Conducted Emission and Radiated Emission tests

*3) Used for Conducted Emission test only

List of cables used

| No. | Name | Length (m) | Shield | | Remarks |
|-----|---------------|------------------|------------|------------|---------|
| | | | Cable | Connector | |
| 1 | Flat Cable | 1.9 *1), 0.3 *2) | Unshielded | Unshielded | - |
| 2 | DC Cable | 1.4 | Unshielded | Unshielded | *3) |
| 2' | DC Cable | 1.4 | Unshielded | Unshielded | - |
| 3 | AC Cable | 2.9 | Unshielded | Unshielded | *3) |
| 4 | DC Cable | 1.4 | Unshielded | Unshielded | - |
| 5 | AC Cable | 1.8 | Unshielded | Unshielded | - |
| 6 | RS-232C Cable | 2.0 | Shielded | Shielded | - |
| 7 | USB Cable | 1.0 | Shielded | Shielded | - |
| 8 | USB Cable | 1.0 | Shielded | Shielded | - |
| 9 | USB Cable | 1.0 | Shielded | Shielded | - |
| 10 | DC Cable | 1.8 | Shielded | Shielded | - |
| 11 | AC Cable | 1.0 | Unshielded | Unshielded | - |

*1) Used for Radiated Emission (above 1GHz) test

*2) Used for other tests than Radiated Emission (above 1GHz)

*3) Used for Conducted Emission test only

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SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a wooden table of nominal size, 1.0m by 1.5m, raised 0.8m above the conducting ground plane. The rear of tabletop was located 40cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80cm from a Line Impedance Stabilization Network (LISN)/ Artificial mains Network (AMN) and excess AC cable was bundled in center.

For the tests on EUT with other peripherals (as a whole system)

I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane. All unused 50ohm connectors of the LISN(AMN) were resistivity terminated in 50ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.

The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

| | |
|--------------------------|---------------------|
| Detector | : QP and AV |
| Measurement range | : 0.15-30MHz |
| Test data | : APPENDIX |
| Test result | : Pass |

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SECTION 6: Radiated Spurious Emission

Test Procedure

It was measured based on "2. Radiated emission test" of "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247".

EUT was placed on a urethane platform of nominal size, 1.0m by 1.0m, raised 0.8m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

The height of the measuring antenna varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

| | | | | |
|--------------|-------------|-----------------|----------------|------------|
| Frequency | Below 30MHz | 30MHz to 300MHz | 300MHz to 1GHz | Above 1GHz |
| Antenna Type | Loop | Biconical | Logperiodic | Horn |

In any 100kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

20dBc was applied to the frequency over the limit of FCC 15.209 / Table 5 of RSS-Gen 7.2.5(IC) and outside the restricted band of FCC15.205 / Table 3 of RSS-Gen 7.2.2 (IC).

| | | | | |
|-----------------|----------------|---|----------------------------|---|
| Frequency | Below 1GHz | Above 1GHz | | 20dBc |
| Instrument used | Test Receiver | Spectrum Analyzer | | Spectrum Analyzer |
| Detector | QP | PK | AV | PK |
| IF Bandwidth | BW 120kHz(T/R) | RBW: 1MHz VBW: 3MHz | RBW: 1MHz VBW: 10Hz *1) | RBW: 100kHz VBW: 300kHz (S/A) |
| Test Distance | 3m | 3m (below 10GHz), 1m*2) (above 10GHz), | | 3m (below 10GHz), 1m*2) (above 10GHz), |

*1) The test was performed with VBW 10Hz since the EUT had no intervals during which the transmitter was off (see Appendix).

*2) Distance Factor: $20 \times \log(3.0\text{m}/1.0\text{m}) = 9.5\text{dB}$

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Measurement range : 30M-25GHz
Test data : APPENDIX
Test result : Pass

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SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

The tests were made with below setting connected to the antenna port.

| Test | Span | RBW | VBW | Sweep time | Detector | Trace | Instrument used |
|--|--|-----------------|--------------------|-------------------|-----------------|--------------|--------------------------------|
| 6dB Bandwidth | 20MHz | 100kHz | 300kHz | Auto | Peak | Max Hold | Spectrum Analyzer |
| 99% Occupied Bandwidth | Enough width to display 20dB Bandwidth | 1 to 3% of Span | Three times of RBW | Auto | Peak | Max Hold | Spectrum Analyzer |
| Maximum Peak Output Power | - | - | - | Auto | Peak | - | Power Meter (Sensor: 50MHz BW) |
| Peak Power Density | 18MHz | 30kHz | 100kHz | 600sec | Peak | Max Hold | Spectrum Analyzer *1) *2) |
| Conducted Spurious Emission *3) | 9kHz to 150kHz | 200Hz | 620Hz | Auto | Peak | Max Hold | Spectrum Analyzer |
| | 150kHz to 30MHz | 9.1kHz | 27kHz | | | | |
| | 30MHz to 25GHz (Less or equal to 5GHz) | 100kHz | 300kHz | | | | |
| Conducted Spurious Emission Band Edge compliance | 100MHz | 100kHz | 300kHz | Auto | Peak | Max Hold | Spectrum Analyzer |

*1) PSD Option 1 of "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247".

*2) The test was not performed at RBW:3kHz however the measurement is to be performed with RBW:3kHz in the regulation, because, the measurement value with RBW:3kHz is less than the value of RBW:30kHz and the test data met the limit with RBW:30kHz.

*3) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents. Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.(9kHz-150kHz:RBW=200Hz, 150kHz-30MHz:RBW=9.1kHz)

The test results and limit are rounded off to two decimals place, so some differences might be observed.

Test data : APPENDIX
Test result : Pass